2012 INTERNATIONAL ENERGY CONSERVATION CODE

Significant Changes

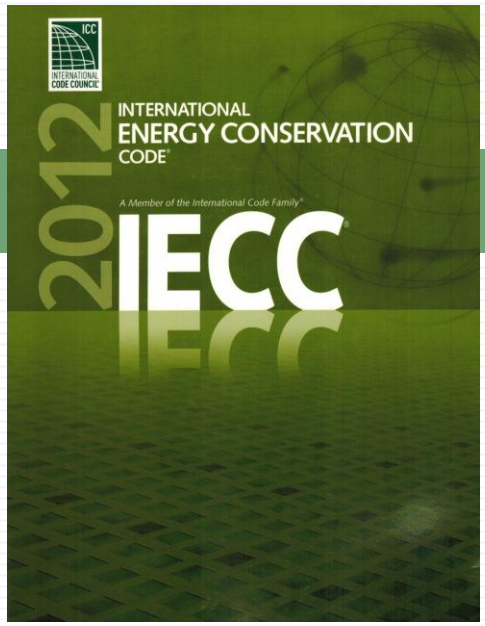
Agenda

2

1. 2012 IECC – Significant Changes
   a) Organizational
   b) Commercial
   c) Residential

3

2012 IECC



Organizational Changes

4

- Two separate sets of provisions
  - Commercial
    - All buildings except for residential buildings 3 stories or less in height
  - Residential
    - Detached one- and two-family dwellings
    - Multiple single family dwellings
    - Group R-2, R-3 and R-4 buildings 3 stories or less in height

Table of Contents

5

- Chapter 1 – Scope and Administration
- Chapter 2 - Definitions
- Chapter 3 – General Requirements
- Chapter 4 – Energy Efficiency
  - Commercial
  - Residential
- Chapter 5 – Referenced Standards

Each code section is preceded by a letter. "C" for Commercial provisions and "R" for Residential provisions

6

Overview - Commercial

Chapter 1 (CE) Scope and Administration

7

- C101.2 Scope
  - Applies to commercial buildings
- C101.3 – Intent
  - Added - over the useful life of each building
- C106.1 – Referenced codes and standards
  - Adds two subsections and clarifies when standards are to be considered
    - C106.1.1 Conflicts
    - C106.1.2 Provision in referenced codes and standards

Chapter 2 (CE) Definitions

8

- Revised definitions
  - Buildings – added - including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building
  - Skylight – changed measurement from a slope of 15° or more from vertical to 60° or less from horizontal
  - Storefront – added - with or without mulled windows and doors

Chapter 2 (CE) Definitions

9

- New definitions
  - Building Commissioning
  - Building Entrance
  - Building Site
  - Coefficent of Performance (COP) – Cooling
  - Coefficent of Performance (COP) – Heating
  - Continuous Air Barrier
  - Demand Recirculation Water System
  - Dynamic Glazing
  - Fenestration Product, Field-Fabricated
  - Fenestration Product, Site-Built
  - Furnace Electricity Ratio
  - General Lighting
  - Integrated Part Load Value (IPLV)
  - Nonstandard Part Load Value (NPLV)
  - On-Site Renewable Energy
  - Residential Building
  - Skylight
  - Visible Transmittance (VT)

Chapter 3 (CE) General Requirements

10

- Revised C303.1.3 Fenestration product rating
  - Added Visible Transmittance (VT) to the NFRC 200

TABLE C303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

Chapter 4 (CE) Commercial Energy Efficiency

11

- C401.2 Application
  - Projects shall comply with one of the following
    1. ANSI/ASHRAE/IESNA 90.1
    2. Sections C402, C043, C404 and C405, and with either Section C406.2, C406.3, or C406.4
    3. Section C407, C402.4, C403.2, C404, C405.2, C405.3, C405.4, C405.6 and C405.7
       - The building energy costs shall be ≤85% of the standard reference design building

Chapter 4 (CE) Commercial Energy Efficiency

12

- C401.2.1 Application to existing buildings
  - Additions, alterations and repairs to existing buildings shall comply with
    1. Sections C402, C403, C404 and C405
    2. ANSI/ASHRAE/IESNA 90.1

Chapter 4 (CE) – Table C402.1.2

13

TABLE C402.1.2
OPAQUE THERMAL ENVELOPE ASSEMBLY REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.039	U-0.039	U-0.039	U-0.039	U-0.032	U-0.032	U-0.028	U-0.028	U-0.028	U-0.028
Metal buildings	U-0.044	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.035	U-0.031	U-0.031	U-0.029	U-0.029	U-0.029	U-0.029
Attic and other	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021	U-0.021
Walls, Above Grade																
Mass	U-0.142	U-0.142	U-0.142	U-0.123	U-0.110	U-0.104	U-0.104	U-0.090	U-0.078	U-0.078	U-0.078	U-0.071	U-0.061	U-0.061	U-0.061	U-0.061
Metal building	U-0.079	U-0.079	U-0.079	U-0.079	U-0.079	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.052	U-0.039	U-0.052	U-0.039
Metal framed	U-0.077	U-0.077	U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.064	U-0.052	U-0.045	U-0.045
Wood framed and other	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, Below Grade																
Below-grade wall[b]	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.092	C-0.092	C-0.092	C-0.092
Floors																
Mass	U-0.322	U-0.322	U-0.107	U-0.087	U-0.076	U-0.076	U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.057	U-0.055	U-0.051	U-0.055	U-0.051
Joist/framing	U-0.066	U-0.066	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-Grade Floors																
Unheated slabs	F-0.73	F-0.73	F-0.73	F-0.73	F-0.73	F-0.73	F-0.54	F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.40	F-0.40	F-0.40	F-0.40
Heated slabs	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.70	F-0.65	F-0.65	F-0.58	F-0.58	F-0.58	F-0.58	F-0.55	F-0.55	F-0.55	F-0.55

a. Use of opaque assembly *U*-factors, *C*-factors, and *F*-factors from ANSI/ASHRAE/IESNA 90.1 Appendix A shall be permitted, provided the construction complies with the applicable construction details from ANSI/ASHRAE/IESNA 90.1 Appendix A.
b. Where heated slabs are below grade, below-grade walls shall comply with the *F*-factor requirements for heated slabs.

Chapter 4 (CE) – Table C402.2

14

TABLE C402.2
OPAQUE THERMAL ENVELOPE REQUIREMENTS[a]

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R	All Other	Group R
Roofs																
Insulation entirely above deck	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-30ci	R-30ci	R-35ci	R-35ci	R-35ci	R-35ci
Metal buildings (with R-5 thermal blocks)[b, c]	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-19 + R-11 LS	R-25 + R-11 LS	R-25 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS	R-30 + R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49	R-49	R-49	R-49	R-49	R-49
Walls, Above Grade																
Mass	R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci
Metal building	R-13 + R-6.5ci	R-13 + R-6.5ci	R13 + R-6.5ci	R-13 + R-13ci	R-13 + R-6.5ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-13ci	R-13 + R-19.5ci	R-13 + R-13ci	R-13 + R-19.5ci
Metal framed	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-7.5ci	R-13 + R-15.6ci	R-13 + R-7.5ci	R-13 + R17.5ci
Wood framed and other	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-7.5ci or R-20 + R-3.8ci	R-13 + R-15.6ci or R-20 + R-10ci	R-13 + R-15.6ci or R-20 + R-10ci
Walls, Below Grade																
Below-grade wall[d]	NR	NR	NR	NR	NR	NR	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-10ci	R-10ci	R-10ci	R-12.5ci
Floors																
Mass	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-12.5ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci
Joist/framing	NR	NR	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30	R-30[e]	R-30[e]	R-30[e]	R-30[e]	R-30[e]
Slab-on-Grade Floors																
Unheated slabs	NR	NR	NR	NR	NR	NR	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 24" below	R-20 for 24" below
Heated slabs[f]	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-7.5 for 12" below	R-10 for 24" below	R-10 for 24" below	R-15 for 24" below	R-15 for 24" below	R-15 for 36" below	R-15 for 36" below	R-15 for 36" below	R-20 for 48" below	R-20 for 24" below	R-20 for 48" below	R-20 for 48" below	R-20 for 48" below
Opaque Doors																
Swinging	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.61	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37	U-0.37
Roll-up or sliding	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75	R-4.75

For SI: 1 inch = 25.4 mm. ci = Continuous Insulation. NR = No requirement.
LS = Liner System—A continuous membrane installed below the purlins and uninterrupted by framing members. Uncompressed, unfaced insulation rests on top of the membrane between the purlins.
a. Assembly descriptions can be found in ANSI/ASHRAE/IESNA Appendix A.
b. Where using *R*-value compliance method, a thermal spacer block shall be provided, otherwise use the *U*-factor compliance method in Table C402.1.2.
c. R-5.7ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with materials having a maximum thermal conductivity of 0.44 Btu-in/h-ft²-°F.
d. Where heated slabs are below grade, below-grade walls shall comply with the exterior insulation requirements for heated slabs.
e. Steel floor joist systems shall be insulated to R-38.

Chapter 4 (CE)
Building Thermal Envelope

15

- C402.2 Specific insulation requirements
  - Added requirements for layering continuous insulation boards
- C402.2.1 Roof assembly
  - Added requirements for skylight curbs to be insulated to level of roofs
    - Exception for curbs included in NFRC assembly

Chapter 4 (CE)
Building Thermal Envelope

16

- C402.2.1.1 Roof solar reflectance and thermal emittance
  - Low-sloped roofs above cooled conditioned space in Climate Zones 1, 2, 3 shall comply with Table C402.2.1.1

TABLE C402.2.1.1
MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS[a]

Three-year aged solar reflectance[b] of 0.55 and three-year aged thermal emittance[c] of 0.75
Initial solar reflectance[b] of 0.70 and initial thermal emittance[c] of 0.75
Three-year-aged solar reflectance index[d] of 64
Initial solar reflectance index[d] of 82

a. The use of area-weighted averages to meet these requirements shall be permitted. Materials lacking initial tested values for either solar reflectance or thermal emittance, shall be assigned both an initial solar reflectance of 0.10 and an initial thermal emittance of 0.90. Materials lacking three-year aged tested values for either solar reflectance or thermal emittance shall be assigned both a three-year aged solar reflectance of 0.10 and a three-year aged thermal emittance of 0.90.

b. Solar reflectance tested in accordance with ASTM C 1549, ASTM E 903 or ASTM E 1918.

c. Thermal emittance tested in accordance with ASTM C 1371 or ASTM E 408.

d. Solar reflectance index (SRI) shall be determined in accordance with ASTM E 1980 using a convection coefficient of 2.1 Btu/h × ft² × °F (12W/m² × K). Calculation of aged SRI shall be based on aged tested values of solar reflectance and thermal emittance. Calculation of initial SRI shall be based on initial tested values of solar reflectance and thermal emittance.

Chapter 4 (CE)
Building Thermal Envelope

17

- Exceptions –
  - Portions of roof covered by
    - Photovoltaic systems
    - Solar air or water heating systems
    - Roof gardens
    - Above roof decks
    - Skylights
    - HVAC systems
  - Portions of roof shaded during peak sun angle
  - Portions of roof that are ballasted
  - Roofs where 75% of roof area meets one of the above

Chapter 4 (CE)
Building Thermal Envelope

18

- C402.2.6 Slabs on grade
  - Added requirement for protection of insulation extending away from the building
  - Exception – when the slab on grade is greater than 24" below the finished exterior
- C402.2.8 Insulation of radiant heating systems (new section)
  - Minimum insulation requirements for system components and the floor structures incorporating the heating

Chapter 4 (CE) Fenestration

19

- C402.3 Fenestration
  - C402.3.1 Maximum area – reduced to 30%
    - C402.3.1.1 Increased vertical fenestration area with daylighting controls
      - Increase max fenestration to 40% provided
        - No less than 50% of conditioned floor has daylighting
        - Automatic daylighting controls are used
        - VT of fenestration is 1.1 times SHGC
          - Exception – fenestration outside scope of NFRC 200
    - C402.3.1.2 Increased skylight area with daylighting controls – increased to 5%

Table C402.3

20

TABLE C402.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION

CLIMATE ZONE	1	2	3	4 EXCEPT MARINE	5 AND MARINE 4	6	7	8
Vertical fenestration								
U-factor								
Fixed fenestration	0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29
Operable fenestration	0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37
Entrance doors	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77
SHGC								
SHGC	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
Skylights								
U-factor	0.75	0.65	0.55	0.50	0.50	0.50	0.50	0.50
SHGC	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

Chapter 4 (CE) Fenestration

21

- C402.3.2 Minimum skylight fenestration area (new section)
  - Enclosed space greater than 10,000 sq. ft.,
  - Directly under a roof with ceiling heights greater than 15 feet, and
  - Used as an office, lobby, atrium, concourse, corridor, storage, gym/exercise center, convention center, auto service, manufacturing, non-refrigerated warehouse, retail store, distribution area, transportation or workshop

Minimum Skylights

22

- Total daylight – not less than half the floor area and provide a minimum skylight to daylight of either
  - Not less than 3% of a skylight VT of at least 0.40
  - Provide a minimum skylight effective aperture of at least 1% determined in accordance with Equation 4-1
  - Exceptions

Chapter 4 (CE) Fenestration

23

- C402.3.2.1 Lighting controls in daylight zones under skylights (new section)
  - All lighting in the daylight zone shall be controlled by multilevel lighting controls
  - Exceptions
- C402.3.2.2 Haze factor
  - Skylights in listed occupancies shall have a glazing material or diffuser with a measured haze factor greater than 90% when tested according to ASTM 1003
  - Exceptions

Chapter 4 (CE) Fenestration

24

- C402.3.3 Maximum *U*-factor and SHGC
  - Additional language – "Where different windows or glass doors have different PF values, they shall each be evaluated separately"
- C402.3.3.1 SHGC adjustment
  - Where the PF is greater than or equal to 0.2, the required maximum SHGC shall be adjusted using Table C402.3.3.1

TABLE C402.3.3.1
SHGC ADJUSTMENT MULTIPLIERS

PROJECTION FACTOR	ORIENTED WITHIN 45 DEGREES OF TRUE NORTH	ALL OTHER ORIENTATION
$0.2 \le PF < 0.5$	1.1	1.2
$PF \le 0.5$	1.2	1.6

Chapter 4 (CE) Fenestration

25

- C402.3.3.2 Increased vertical fenestration
  - Climate Zones 1, 2, and 3, fenestration located not less than 6' above the finished floor may increase SHGC to 0.40
- C402.3.3.3 Increased skylight SHGC
  - Climate Zones 1 - 6, maximum SHGC 0.60 where located above daylight zones with automated controls

Chapter 4 (CE) Fenestration

26

- C402.3.3.4 Increased skylight *U*-factor
  - When skylights are installed above daylight zones with automatic controls, a maximum *U*-factor
    - 0.9 in Climate Zones 1 – 3
    - 0.75 in Climate Zones 4 - 8
- C402.3.3.5 Dynamic glazing
  - Shall be considered separately from other fenestration
  - SHGC – manufacturer's lowest-rated
  - VT/SHGC ratio – use maximum VT and SHGC

Chapter 4 (CE) Fenestration

27

- C402.3.4 Area-weighted *U*-factor
  - Area-weighted average permitted for each fenestration product category
  - Individual fenestration products from difference fenestration product categories shall not be combined in calculation

Chapter 4 (CE) Air Leakage

28

- C402.4 Air leakage
  - C402.4.1 Air barriers (new section)
    - Continuous air barrier shall be provided
    - Exception – Climate Zones 1, 2 and 3
  - C402.4.1.1 Air barrier construction
    1. Continuous for all assemblies that are the thermal envelope – including joints and assemblies
    2. Air barrier joints and seams shall be sealed
    3. Recessed lighting fixtures shall comply with C404.2.8 and similar penetrations shall maintain the integrity of the air barrier
    - Exception – Compliance with C402.1.2.3 - not required to comply with Items 1 and 3

Chapter 4 (CE) Air Leakage

29

- C402.4.1.2 Air barrier compliance options
  - Comply with C402.4.1.2.1, C402.4.1.2.2, or C402.4.1.2.3
    - C402.4.1.2.1 Materials
      - Joints must be sealed and materials are installed as air barriers in accordance with manufacturer's instructions
        - 3/8" plywood or oriented strand board
        - ½" extruded polystyrene insulation board
        - ½" foil-back polyisocyanurate insulation board
        - Closed cell spray foam – 1.5 pcf density - 1½" thick
        - Open cell spray foam – 0.4 – 1.5 pcf density – 4.5" thick
        - ½" cement board or exterior or interior gypsum board
        - Built-up roofing membrane
        - Modified bituminous roof membrane
        - Fully adhered single-ply roof membrane
        - 5/8" gypsum plaster or Portland cement/sand parge
        - Cast-in-place or precast concrete
        - Full grouted concrete block masonry
        - Sheet steel or aluminum

Chapter 4 (CE) Air Leakage

30

- C402.4.1.2.2 Assemblies
  - Materials and components tested with ASTM E 2357, ASTM E 1677 or ASTM 3 283
  - An average air leakage not to exceed 0.04 cfm, tested at 0.3" w.g.(75 Pa)
- C402.4.1.2.3 Building Test
  - Completed building tested in accordance with ASTM E 779
  - Leakage not to excee 0.04 cfm, tested at 0.3" w.g. (75 Pa)

Chapter 4 (CE) Air Leakage

31

- C402.4.2 Air barrier penetrations
  - Added language clarifying sealing requirements
- C402.4.3 Air leakage of fenestration
  - Table C402.4.3

TABLE C402.4.3
MAXIMUM AIR INFILTRATION RATE FOR FENESTRATION ASSEMBLIES

FENESTRATION ASSEMBLY	MAXIMUM RATE(CFM/FT²)	TEST PROCEDURE
Windows	0.20[a]	AAMA/WDMA/ CSA101/I.S.2/A440 or NFRC 400
Sliding doors	0.20[a]	
Swinging doors	0.20[a]	
Skylights – with condensation weepage openings	0.30	
Skylights – all other	0.20[a]	
Curtain walls	0.06	NFRC 400 or ASTM E 283 at 1.57 psf (75 Pa)
Storefront glazing	0.06	
Commercial glazed swinging entrance doors	1.00	
Revolving doors	1.00	
Garage doors	0.40	ANSI/DASMA 105, NFRC 400, or ASTM E 283 at 1.57 psf (75 Pa)
Rolling doors	1.00	

For SI: 1 cubic foot per minute = 0.47L/s, 1 square foot = 0.093 m².

a. The maximum rate for windows, sliding and swinging doors, and skylights is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa).

Chapter 4 (CE) Air Leakage

32

- C402.4.4 Doors and access openings to shafts chutes, stairways and elevator lobbies
  - Exception
- C402.4.5 Air intakes, exhaust openings, stairways and shafts
  - C402.4.5.1 Stairway and shaft vents
  - C402.4.5.2 Outdoor air intakes and exhausts
    - Exceptions

Chapter 4 (CE) Air Leakage

33

- C402.4.7 Vestibules
  - Added all building entrances
  - Added the installation of revolving doors in the building entrance shall not eliminate the vestibule on any door adjacent to the revolving door
  - Exceptions
    - Added doors intended solely for employee use to exception 2

Chapter 4 (CE) Air Leakage

34

- C402.4.8 Recessed lighting
  - Removed language addressing air movement from the conditioned space to the ceiling cavity.

Chapter 4 (CE) Mechanical

35

- C403.2.1 Calculation of heating and cooling loads
  - Added – The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design
- C403.2.2 Equipment and system sizing
  - Clarified the output capacity of heating and cooling equipment systems shall not exceed the loads calculated

Chapter 4 (CE) Mechanical

36

- C403.2.3 HVAC equipment performance requirements
  - Added – Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of Table C403.2.3(9)
- C403.2.3.1 Water-cooled centrifugal chilling packages
  - Changed the formulas
    - Adjusted minimum full-load COP ratings
    - Adjusted minimum NPLV rating
  - Exception – chillers designed to operate outside these ranges need not comply

Chapter 4 (CE) Mechanical

37

- Table C403.2.3(1)
- Table C403.2.3(2)
- Table C403.2.3(3)
- Table C403.2.3(4)
- Table C403.2.3(5)
- Table C403.2.3(6)
- Table C403.2.3(7)
- Table C403.2.3(8)
- Table C403.2.3(9)

Chapter 4 (CE) Mechanical

38

- C403.2.3.2 Positive displacement (air- and water-cooled) chilling packages (new)
  - Equipment with a leaving fluid temperature higher than 32°F shall meet Table C403.2.3(7)
- C403.2.4.3.3 Automatic start capabilities (new)
  - Controls shall be provided for each HVAC system
  - Capable of automatically adjusting the daily start time in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy

Chapter 4 (CE) Mechanical

39

- C403.2.5.1 Demand controlled ventilation
  - Reduced average occupant load to 25 people
- Exception
  - Additional exception where demand control ventilation is not required
    - Ventilation provided for process loads only

Chapter 4 (CE) Mechanical

40

- C403.2.6 Energy recovery ventilation systems
  - Required where the supply airflow rate of a fan system exceeds the values specified in Table C403.2.6
  - Changes to Exceptions 5,6,and 7 – added 8 and 9
    - 5. Changed to Climate Zones 1 and 2
    - 6. Changed to Climate Zones 3C, 4C, 5B, 5C, 6B, 7 and 8
    - 7. Changed to dehumidification that employ energy recovery in series with the cooling coil
    - Where the largest source of exhausted air at a single location is less than 75% of the design outdoor air flow
    - Systems expected to operate less than 20 hrs per week at the outdoor air % covered by Table C403.2.6

Chapter 4 (CE) Mechanical

41

- Table C403.2.6

TABLE C403.2.6
ENERGY RECOVERY REQUIREMENT

CLIMATE ZONE	PERCENT (%) OUTDOOR AIR AT FULL DESIGN AIRFLOW RATE					
	≥ 30% and < 40%	≥ 40% and < 50%	≥ 50% and < 60%	≥ 60% and < 70%	≥ 70% and < 80%	≥ 80%
	DESIGN SUPPLY FAN AIRFLOW RATE (cfm)					
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	≥ 5000	≥ 5000
1B, 2B, 5C	NR	NR	≥ 26000	≥ 12000	≥ 5000	≥ 4000
6B	≥ 11000	≥ 5500	≥ 4500	≥ 3500	≥ 2500	≥ 1500
1A, 2A, 3A, 4A, 5A, 6A	≥ 5500	≥ 4500	≥ 3500	≥ 2000	≥ 1000	> 0
7, 8	≥ 2500	≥ 1000	> 0	> 0	> 0	> 0

NR = not required

Chapter 4 (CE) Mechanical

42

- C403.2.7.1.3 High-pressure duct systems
  - Changed formula – $CL = F/P^{0.65}$
- C403.2.8 Piping insulation
  - Changed Table C403.2.8
  - Exceptions
    - 3. Increased minim temperature to 60°F
    - 5. Replaced with new requirements
      - Removed exception for runout piping
      - Strainers, control valves, and balancing valves associated with piping 1" or less
    - 6. Added direct buried piping that conveys fluids at or below 60°F

Chapter 4 (CE) Mechanical

43

TABLE C403.2.8
MINIMUM PIPE INSULATION THICKNESS (thickness in inches)[a]

FLUID OPERATING TEMPERATURE RANGE AND USAGE (°F)	INSULATION CONDUCTIVITY		NOMINAL PIPE OR TUBE SIZE (inches)				
	Conductivity Btu · in./(h · ft² · °F)[b]	Mean Rating Temperature, °F	< 1	1 to < 1 1/2	1 1/2 to < 4	4 to < 8	≥ 8
> 350	0.32 – 0.34	250	4.5	5.0	5.0	5.0	5.0
251 – 350	0.29 – 0.32	200	3.0	4.0	4.5	4.5	4.5
201 – 250	0.27 – 0.30	150	2.5	2.5	2.5	3.0	3.0
141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
40 – 60	0.21 – 0.27	75	0.5	0.5	1.0	1.0	1.0
< 40	0.20 – 0.26	75	0.5	1.0	1.0	1.0	1.5

a. For piping smaller than 1 1/2 inch (38 mm) and located in partitions within *conditioned spaces*, reduction of these thicknesses by 1 inch (25 mm) shall be permitted (before thickness adjustment required in footnote b) but not to a thickness less than 1 inch (25 mm).

b. For insulation outside the stated conductivity range, the minimum thickness (T) shall be determined as follows:

$$T = r\{(1 + t/r)^{K/k} - 1\}$$

where:

T = minimum insulation thickness,
r = actual outside radius of pipe,
t = insulation thickness listed in the table for applicable fluid temperature and pipe size,
K = conductivity of alternate material at mean rating temperature indicated for the applicable fluid temperature (Btu × in/h × ft² × °F) and
k = the upper value of the conductivity range listed in the table for the applicable fluid temperature.

c. For direct-buried heating and hot water system piping, reduction of these thicknesses by 1 1/2 inches (38 mm) shall be permitted (before thickness adjustment required in footnote b but not to thicknesses less than 1 inch (25 mm).

Chapter 4 (CE) Mechanical

44

- C403.2.8.1 Protection of piping insulation (new)
  - Piping insulation exposed to weather shall be protected from damage, including
    - Sunlight
    - Moisture
    - Equipment maintenance
    - Wind
    - Shielding from solar radiation
  - Adhesive tape is not permitted

Chapter 4 (CE) Mechanical

45

- C403.2.9 Mechanical systems commissioning and completion requirements
  - Shall meet requirements in C408.2
- C403.2.10.1 Allowable fan floor horsepower
  - Added – Single zone variable-air-volume systems shall comply with the constant volume fan power limitation
- Exception
  - 1. Added vivarium
  - 3. Removed

Chapter 4 (CE) Mechanical

46

- Table C403.2.10.1(1)
  - Changes to footnotes

TABLE C403.2.10.1(1)
FAN POWER LIMITATION

	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \le CFM_s \times 0.0011$	$hp \le CFM_s \times 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \le CFM_s \times 0.00094 + A$	$bhp \le CFM_s \times 0.0013 + A$

where:

CFM_s = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.
hp = The maximum combined motor nameplate horsepower.
Bhp = The maximum combined fan brake horsepower.
A = Sum of $[PD \times CFM_D / 4131]$

For SI: 1 cfm = 0.471 L/s.

where:

PD = Each applicable pressure drop adjustment from Table C403.2.10.1(2) in. w.c.
CFM_D = The design airflow through each applicable device from Table C403.2.10.1(2) in cubic feet per minute.

For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W.

Chapter 4 (CE) Mechanical

47

- Table C403.2.10.1(2)
  - Added devices
  - Changes to adjustments on some devices

TABLE C403.2.10.1(2)
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

DEVICE	ADJUSTMENT
Credits	
Fully ducted return and/or exhaust air systems	0.5 inch w.c. (2.15 in w.c. for laboratory and vivarium systems)
Return and/or exhaust air flow control devices	0.5 inch w.c.
Exhaust filters, scrubbers, or other exhaust treatment.	The pressure drop of device calculated at fan system design condition
Particulate filtration credit: MERV 9 thru 12	0.5 inch w.c.
Particulate filtration credit: MERV 13 thru 15	0.9 inch. w.c.
Particulate filtration credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2x clean filter pressure drop at fan system design condition.
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition.
Biosafety cabinet	Pressure drop of device at fan system design condition.
Energy recovery device, other than coil runaround loop	(2.2 × energy recovery effectiveness) – 0.5 inch w.c. for each airstream
Coil runaround loop	0.6 inch w.c. for each airstream
Evaporative humidifier/cooler in series with another cooling coil	Pressure drop of device at fan system design conditions
Sound attenuation section	0.15 inch w.c.
Exhaust system serving fume hoods	0.35 inch w.c.
Laboratory and vivarium exhaust systems in high-rise buildings	0.25 inch w.c./100 feet of vertical duct exceeding 75 feet

w.c. = water column
For SI:1 inch w.c. = 249 Pa, 1 inch = 25.4 mm.

Chapter 4 (CE) Mechanical

48

- C403.3 Simple HVAC systems
  - Economizers - each cooling system that has a fan shall include either an air or water economizer meeting C403.3.1.1 – C403.1.1.4
  - Exception
    - Individual units with a supply less than the minimum in Table c403.3.1(1)
    - Where more than 25% of the air designed to be supplied is to spaces that are to be humidified above 35% dew-point temperature to satisfy process needs

Chapter 4 (CE) Mechanical

49

- C403.3 Simple HVAC systems
  - Economizers –Exceptions continued
    - Systems that serve residential spaces where the capacity is less than five times the requirement listed in Table C403.3.1(1)

TABLE C403.3.1(1)
ECONOMIZER REQUIREMENTS

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B	No requirement
2A, 2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, 8	Economizers on all cooling systems ≥ 33,000 Btu/h[a]

For SI:1 British thermal unit per hour = 0.2931 W.

a. The total capacity of all systems without economizers shall not exceed 300,000 Btu/h per *building*, or 20 percent of its air economizer capacity, whichever is greater.

Chapter 4 (CE) Mechanical

50

- C403.3 Simple HVAC systems
  - Economizers –Exceptions continued
    - Systems expected to operate less than 20 hours a week
    - Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems
    - Where the cooling efficiency meets or exceeds the efficiency requirements in Table C403.3.1(2)

TABLE C403.3.1(2)
EQUIPMENT EFFICIENCY PERFORMANCE EXCEPTION FOR ECONOMIZERS

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

Chapter 4 (CE) Mechanical

51

- C403.3.1.1 Air economizers (new)
  - C403.3.1.1.1 Design capacity
    - System shall be capable of modulating outdoor air and return air dampers to provide up to 100% of design supply air quantity as outdoor air for cooling
  - C403.3.1.1.2 Control signal
    - Dampers capable of being sequenced with the cooling equipment and not controlled only by mixed air temperature
    - Exception
      - Use of mixed air temperature limit control shall be permitted for some systems such as single-zone systems

Chapter 4 (CE) Mechanical

52

- C403.3.1.1.3 High-limit shutoff
  - Capable of automatically reducing outdoor air intake to the minimum quantity when intake will not longer reduce cooling energy usage
  - High-limit shutoff control types for specific climates shall be from Table C403.3.1.1.3(1)
  - High-limit shutoff control settings for these control types shall be as specified in Table C403.3.1.1.3(2)

Chapter 4 (CE) Mechanical

53

- C403.3.1.1.4 Relief of excess outdoor air
  - Capable of relieving excess outdoor air during air economizer operation to prevent over-pressurizing the building.
  - Locate the relief valve to avoid recirculation into the building

Chapter 4 (CE) Mechanical

54

- C403.4 Complex HVAC systems
  - C403.4.1 Economizers
    - Removed air economizers
  - C403.4.1.1 Design capacity – water economizers
    - Cooling by indirect evaporation
    - Provide up to 100% of the expected cooling load
    - Outdoor air temperatures of 50°F dry bulb/45°F wet bulb
    - Expected system cooling load at 45°F dry bulb/40°F wet bulb
  - Exception
    - Where dehumidification requirements cannot be met

Chapter 4 (CE) Mechanical

55

- C403.4.1.2 Maximum pressure drop
  - Precooling coils and water-to-water heat exchangers used as part of a water economizer system shall either have a water-side pressure drop of less than 15' or a secondary loop shall be created so that the pressure drop is not seen by the circulating pumps, when the system is in the normal (noneconomizer) mode

Chapter 4 (CE) Mechanical

56

- C403.4.1.3 Integrated economizer control
  - Economizers shall be integrated with the cooling system and capable of providing partial cooling
  - Capable of providing partial cooling
    - Even where additional mechanical cooling is required
  - Exception
    - Direct expansion systems that include controls that reduce the quantity of outdoor air required to prevent coil frosting
    - Individual direct expansion units that have a capacity less than 54,000 Btu/h and use nonintegrated controls that preclude simultaneous operations

Chapter 4 (CE) Mechanical

57

- C403.4.1.4 Economizer heating system impact
  - Design and controls shall be such that economizer does not increase the building heating use during normal operation
  - Exception
    - Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature
- C403.4.2 Variable air volume fan control
  - Added driven by a vine-axial fan with variable-pitch blades

Chapter 4 (CE) Mechanical

58

- C403.4.2.1 Static pressure sensor location
  - Sensors used to control VAV fans shall be placed in a position that the controller setpoint is no greater than 1/3 the total design an static pressure
  - Except for systems with zone reset controls
  - Sensors installed down-stream of major duct splits, at lease one-sensor shall be located on each major branch to ensure static pressure can be maintained at each branch

Chapter 4 (CE) Water Heating

59

- C404.5 Pipe Insulation
  - Added heat-traced systems
  - Changed noncirculating systems to non-hot-water-supply temperature maintenance systems
  - Added exception – heat-traced systems shall meet the manufacturer's installation instructions
    - Untraced piping within the heat-traced system shall be insulated
- C404.6 Hot water system controls
  - Changed from when system is not in operation to when there is limited demand
  - Added ready access shall be provided to the operating controls

Chapter 4 (CE) Water Heating

60

- C404.7 Pools and inground permanently installed spas (Mandatory)
  - C404.7.1 Heaters
    - On-off switch to be mounted outside of the heater
  - C404.7.2 Time switches
    - Applies to all, not just swimming pools
    - Heaters, pumps and motors with built in timers shall be deemed in compliance

Chapter 4 (CE) Water Heating

61

- C404.7.3 Covers
  - Added inground permanently installed spas
  - Removed R-value requirements for pools heated to more than 90°F
  - Exception
    - Not required for pools deriving over 70% of the heating energy from site-recovered energy, such as a heat pump or solar energy source computed over an operating season

Chapter 4 (CE) Lighting

62

- C405.1 General
  - Adds electrical energy consumption
  - Exception
    - Increases high efficacy requirement in dwelling units to 75%, exempting low-voltage from that requirement
- C405.2.1 Manual lighting controls
  - Adds requirement that all buildings include manual lighting controls that meet C405.2.1.1 and C405.2.1.2

Chapter 4 (CE) Lighting

63

- C405.2.1.2 Light reduction controls
  - Amends exceptions
    - Areas with only one luminaire, added - with rated power less than 100 watts
    - Expands exception for corridors, storerooms, restrooms or public lobbies to include electrical or mechanical rooms
    - Adds daylight spaces complying with C405.2.2.3.2

Chapter 4 (CE) Lighting

64

- C405.2.2 Additional lighting controls – each area shall also meet C405.2.2.1, C405.2.2.2 and C405.2.2.3
  - Additional exception – lighting intended for continuous operation

Chapter 4 (CE) Lighting

65

- C405.2.2.1 Automatic time switch control devices installed to control lighting in all areas of the building
  - Removed – buildings larger than 5,000 sq. ft.
  - Exceptions
    - Emergency egress lighting
    - Spaces controlled by occupancy sensor
  - Removed Holiday scheduling section and exception

Chapter 4 (CE) Lighting

66

- C405.2.2.2 Occupancy sensors
  - Installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, other enclosed spaces 300 sq. ft. or less
  - Turn off lights within 30 minutes of all occupants leaving the space
  - Manual on or automatically turn the lighting on to not more than 50% power
- Exception
  - Full automatic-on controls permitted in public corridors, stairways, restrooms, primary building entrances areas and lobbies, and where manual-on operation would endanger the safety or security of the room or occupants

Chapter 4 (CE) Lighting

67

- C405.2.2.3 Daylight zone control – add limitation of 2500 sq. ft. per control zone
  - Exception – zones enclosed by wall or partitions and containing two or fewer luminaires not required to have a separate switch for general lighting
- C405.2.2.3.1 Manual daylighting controls (new)
  - Required unless automatic controls are installed

Chapter 4 (CE) Lighting

68

- C405.2.2.3.2 Automatic daylighting controls
  - Setpoint and other controls for calibrating lighting control device shall be readily accessible
  - Reduce the lighting power in response to available daylight by either
    - Continuous dimming using dimming ballast to reduce power to less than 35% of rated power
    - Stepped down dimming, using multi-level switching
    - Two control channels per zone
      - One step between 50% and 70% of design lighting power
      - Another step no greater than 35% of design power

Chapter 4 (CE) Lighting

69

- C405.2.2.3.3 Multi-level lighting controls
  - When multi-level controls are required the general lighting shall be controlled separately by at least one multi-level control that reduces the lighting power in response to daylight available
  - Where the daylight illuminance is greater than the rated illuminance of the general lighting, the general lighting is automatically controlled so that its power draw is no greater than 35% of its rated power
  - Located so that calibration and set point adjustment controls are readily accessible and separate from the light sensor

Chapter 4 (CE) Lighting

70

- C405.2.3 Specific application controls
  - Dedicated controls independent of the controls for other lighting with in the room or space required for
    - Display and accent light
    - Lighting in display cases
    - Lighting for nonvisual applications
      - Plant growth
      - Food warming
    - Lighting equipment for sale or demonstration in lighting education
  - Hotel and motel sleeping units and guest suites
    - Removed exception for the bathroom
  - Supplemental task lighting
    - Permanently installed under shelf/cabinet lighting
    - Control device integral to the luminanires or readily accessible wall-mounted control device

Chapter 4 (CE) Lighting

- C405.5.2 Interior lighting power determined by
  - Building Area Method
    - Interior lighting power allowance = the floor area for each building area type listed x the value from Table C405.5.2(1)
  - Space-by-Space Method
    - Interior lighting power allowance = the floor area of each space x the value for the space type in Table C405.5.2(2) that most closely represents the proposed use of the space and then summing the lighting power allowances for all spaces
    - Tradeoffs among spaces are permitted

TABLE C405.5.2(2)
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE-BY-SPACE TYPES	LPD (w/ft²)
Atrium – First 40 feet in height	0.03 per ft. ht.
Atrium – Above 40 feet in height	0.02 per ft. ht.
Audience/seating area – permanent	
For auditorium	0.9
For performing arts theater	2.6
For motion picture theater	1.2
Classroom/lecture/training	1.30
Conference/meeting/multipurpose	1.2
Corridor/transition	0.7
Dining area	
Bar/lounge/leisure dining	1.40
Family dining area	1.40
Dressing/fitting room performing arts theater	1.1
Electrical/mechanical	1.10
Food preparation	1.20
Laboratory for classrooms	1.3
Laboratory for medical/industrial/research	1.8
Lobby	1.10
Lobby for performing arts theater	3.3
Lobby for motion picture theater	1.0
Locker room	0.80
Lounge recreation	0.8
Office – enclosed	1.1
Office – open plan	1.0
Restroom	1.0
Sales area	1.6[a]
Stairway	0.70
Storage	0.8
Workshop	1.60
Courthouse/police station/penetentiary	
Courtroom	1.90
Confinement cells	1.1
Judge chambers	1.30
Penitentiary audience seating	0.5
Penitentiary classroom	1.3
Penitentiary dining	1.3
BUILDING SPECIFIC SPACE-BY-SPACE TYPES	
Automotive – service/repair	0.70
Bank/office – banking activity area	1.5
Dormitory living quarters	1.10
Gymnasium/fitness center	
Fitness area	0.9
Gymnasium audience/seating	0.40
Playing area	1.40

TABLE C405.5.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

COMMON SPACE-BY-SPACE TYPES	LPD (w/ft²)
Healthcare clinic/hospital	
Corridor/transition	1.00
Exam/treatment	1.70
Emergency	2.70
Public and staff lounge	0.80
Medical supplies	1.40
Nursery	0.9
Nurse station	1.00
Physical therapy	0.90
Patient room	0.70
Pharmacy	1.20
Radiology/imaging	1.3
Operating room	2.20
Recovery	1.2
Lounge/recreation	0.8
Laundry – washing	0.60
Hotel	
Dining area	1.30
Guest rooms	1.00
Hotel lobby	2.00
Highway lodging dining	1.20
Highway lodging guest rooms	1.00
Library	
Stacks	1.70
Card file and cataloguing	1.10
Reading area	1.20
Manufacturing	
Corridor/transition	0.40
Detailed manufacturing	3.1
Equipment room	1.0
Extra high bay (> 50-foot floor-ceiling height)	1.1
High bay (25 – 50-foot floor-ceiling height)	1.20
Low bay (< 25-foot floor-ceiling height)	1.3
Museum	
General exhibition	1.00
Restoration	1.70
Parking garage – garage areas	0.2
Convention center	
Exhibit space	1.50
Audience/seating area	0.90
Fire stations	
Engine room	0.80
Sleeping quarters	0.30
Post office	
Sorting area	0.9
Religious building	
Fellowship hall	0.60
Audience seating	2.40
Worship pulpit/choir	2.40
Retail	
Dressing/fitting area	0.9
Mall concourse	1.6
Sales area	1.6[a]

TABLE C405.5.2(2)—continued
INTERIOR LIGHTING POWER ALLOWANCES: SPACE-BY-SPACE METHOD

BUILDING SPECIFIC SPACE-BY-SPACE TYPES	LPD (w/ft²)
Sports arena	
Audience seating	0.4
Court sports area – Class 4	4.7
Court sports area – Class 3	3.2
Court sports area – Class 2	1.9
Court sports area – Class 1	3.11
Ring sports area	2.7
Transportation	
Air/train/bus baggage area	1.00
Airport concourse	0.60
Terminal – ticket counter	1.50
Warehouse	
Fine material storage	1.40
Medium/bulky material	0.80

For SI: 1 foot = 304.8 mm, 1 watt per square foot = 11 W/m².

a. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below, shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 500 watts + (Retail Area 1 × 0.6 W/ft²) + (Retail Area 2 × 0.6 W/ft²) + (Retail Area 3 × 1.4 W/ft²) + (Retail Area 4 × 2.7 W/ft²).

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 2, 3 or 4.

Retail Area 2 = The floor area used for the sale of vehicles, sporting goods and small electronics.

Retail Area 3 = The floor area used for the sale of furniture, clothing, cosmetics and artwork.

Retail Area 4 = The floor area used for the sale of jewelry, crystal and china.

Exception: Other merchandise categories are permitted to be included as Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.

Chapter 4 (CE) Additional Efficiency Package Options (new)

73

- C406.1 Buildings shall comply with at least one of the following
  1. C406.1.2 Efficient HVAC Performance
  2. C406.1.3 Efficient Lighting Performance
  3. C406.1.4 On-Site Supply of Renewable Energy
- Individual tenant spaces shall comply with either 1 or 2 unless compliance with 3 for the entire building is demonstrated

Chapter 4 (CE) Additional Efficiency Package Options

74

- C406.2 Efficient HVAC performance
  - Meet the efficiency of C406.2(1) – C406.2(7) in addition to C403
  - Only allowed where the equipment efficiencies in this section are greater than C403
- C406.3 Efficient lighting system
  - Total interior lighting power shall be determined by using Table C406.3 x the floor area for the building type

Chapter 4 (CE) Additional Efficiency Package Options

75

- C406.4 On-site renewable energy
  - Total minimum rating shall comply with one of the following
    - Not less than 1.75 Btu/h or not less than 0.50 watts per sq. ft. of conditioned floor space
    - Not less than 3% of the energy used for building mechanical and service water heating equipment and lighting

Chapter 4 (CE) Total Building Performance

76

- No Changes

Chapter 4 (CE)
System Commissioning (new)

77

- C408.1 Commissioning of the building mechanical systems in C403 and electrical power and lighting systems in C405
- C408.2 Mechanical systems commissioning and completion requirements
  - Prior to final mechanical inspection
  - Evidence by a registered design professional
  - Construction document notes clearly indicate provisions
  - Copies of all documents to owner and made available to code official
  - Exceptions
    - Systems in buildings where the total capacity is >480,000 Btu/h cooling and 600,000 Btu/h heating
    - System serving dwelling units and sleeping units in hotels, etc.

Chapter 4 (CE)
System Commissioning - Mechanical

78

- C408.2.1 Commissioning Plan
  - Developed by a registered design professional including
    - Narrative of the activities that will be accomplished during each phase, including personnel
    - Listing of specific equipment, appliances or systems to be tested and a description of tests
    - Functions to be tested, including, but not limited to calibrations and economizer controls
    - Conditions under which test will be performed, at a minimum winter and summer design conditions and full outside air conditions
    - Measurable criteria for performance

Chapter 4 (CE)
System Commissioning

79

- C408.2.2 Systems adjusting and balancing
  - HVAC system shall be balanced in accordance with generally accepted engineering standards
    - Air and water flow rates shall be measured and adjusted to deliver final flow rates within the tolerances provided in the product specifications
    - Test and balance activities shall include air system and hydronic balancing

Chapter 4 (CE)
System Commissioning

80

- C408.2.2.1 Air system handling
  - Relocated from 503.2.9.1
  - Added – air systems shall be balance in a manner to first minimize throttling losses, then
  - For fans with system power greater than 1 hp fan sped shall be adjusted to meet design flow conditions
  - Exception
    - fans with fan motors of 1 hp or less

Chapter 4 (CE)
System Commissioning

81

- C408.2.2.2 Hydronic systems balancing
  - Relocated from 503.2.9.2
  - Added – shall be balanced in a manner to
    - First minimize throttling loses
    - Then the pump impleller shall be trimmed or pump speed adjusted to meet design flow conditions
  - Each hydronic system shall have the capacity to either
    - Measure pressure across the pump
    - Test ports at each side of each pump
  - Exception
    - Pumps with pump motors of 5 hp or less
    - Where throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed

Chapter 4 (CE)
System Commissioning

82

- C408.2.3 Functional performance testing
  - C408.2.3.1 Equipment – demonstrate the
    - Installation and operation of components, systems, and system-to-system interfacing, such that operation, function, and maintenance serviceability for each of the commissioned systems is confirmed
    - Testing shall include all modes and sequence of operation, including
      - Full-load, part-load and the following emergency
        - All modes described in the sequence of operation
        - Redundant or automatic back-up mode
        - Performance of alarms
        - Mode of operation upon loss and restoration of power

Chapter 4 (CE)
System Commissioning

83

- C408.2.3.1 Exception – unitary or packaged equipment in C403.2.3 Tables that do not require supply air economizers
- C408.2.3.2 Controls – tested to document calibration, adjustment, and operation in accordance with plans and specifications for
  - Control devices, components, equipment and systems
- C408.2.3.3 Economizers – functional test for operations within manufacturer's specifications

Chapter 4 (CE)
System Commissioning

84

- C408.2.4 Preliminary commissioning report
  - Report of commissioning test procedures and results, provided to the building owner
  - Completed, identified as "Preliminary Commissioning Report" and certified by the registered design professional or approved agency
    - Itemization of deficiencies that have not been corrected at the time of report preparation
    - Deferred tests that cannot be performed due to climatic conditions
    - Climatic conditions required to perform deferred tests

Chapter 4 (CE)
System Commissioning

85

- C408.2.4.1 Acceptance of report
  - Buildings or portions shall not pass the final mechanical inspection until the code official has received a letter from the building owner that the Preliminary Commissioning Report has been received
- C408.2.4.2 Copy of report
  - Code official may require a copy of the report

Chapter 4 (CE)
System Commissioning

86

- C408.2.5 Documentation requirements
  - Provided to the owner within 90 days of the date of the receipt of the certificate of occupancy
- C408.2.5.1 Drawings
  - Construction documents that include location and performance data on each piece of equipment

Chapter 4 (CE)
System Commissioning

87

- C408.2.5.2 Manuals
  - Submittal data for each piece of equipment requiring maintenance
    - Equipment size and selected options
    - Manufacturer's operation manuals and maintenance manuals
      - Routine maintenance actions shall be clearly identified
      - Except equipment not furnished as part of the project
  - Name and address of at least one service agency
  - HVAC controls system maintenance and calibration information
    - Desired or field-determined setpoints permanently recorded
  - A written narrative on how each system is to operate including recommended setpoints

Chapter 4 (CE)
System Commissioning

88

- C408.2.5.3 System balancing report
  - Written report describing activities completed in accordance with C408.2.2
- Final commissioning report
  - Report of test procedures and results, labeled "Final Commissioning Report" including
    - Functional performance tests results
    - Disposition of deficiencies found during testing including details of corrective measures used or proposed
    - Functional performance test procedures used, including measurable criteria for test acceptance
  - Exception – deferred tests due to climatic conditions

Chapter 4 (CE)
System Commissioning - Lighting

89

- C408.3.1 Functional testing
  - Ensure that control hardware and software are calibrated, adjusted, programmed and in proper working order in accordance with construction documents and manufacturer's installation instructions
  - State party who will be conducting testing
    - Approved third party, when required by the building official
    - Provide documentation certifying that the controls meet the provisions of Section C405

Chapter 4 (CE)
System Commissioning - Lighting

90

- C408.3.1 Functional testing
  - Confirm the following on occupant sensors, programmable schedule controls, photosensors or daylighting controls
    - Placement, sensitivity and time-out adjustments yield acceptable performance
    - Time switches and programmable schedule controls are programmed to turn the lights off
    - Placement and sensitivity adjustments for photosensor controls reduce the electric light based on the amount of usable daylight in the space

Chapter 5 (CE)
Referenced Standards

91

- ANSI/ASHRAE/IESNA 90.2 - 2010

92

Overview – Residential

Chapter 1 (RE) Scope and Administration

93

- R101.2 Scope
  - Applies to Residential buildings
- R101.3 – Intent
  - Added - over the useful life of each building
- R106.1 – Referenced codes and standards
  - Adds two subsections and clarifies when standards are to be considered
    - R106.1.1 Conflicts
    - R106.1.2 Provision in referenced codes and standards

Chapter 2 (RE) Definitions

94

- Revised definitions
  - Buildings – added - including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building
  - Residential Building – rewritten - For this code, includes detached one- and two-family dwellings and multiple single-family dwellings (townhouses), as well as Group R-2, R-3 and R-4 buildings three stories or less in height above grade plane
  - Skylight – changed measurement from a slope of 15 degrees or more from vertical to 60 degrees or less from horizontal.

Chapter 2 (RE) Definitions

95

- New definitions
  - Building Site
  - Continuous Air Barrier
  - Demand Recirculation Water System
  - Fenestration Product, Site-Built
  - Visible Transmittance (VT)
  - Whole House Mechanical Ventilation System

Chapter 3 (RE) General Requirements

96

- Revised R303.1.3 Fenestration product rating
  - Added Visible Transmittance (VT) to the NFRC 200

TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

Chapter 4 (RE) Residential Energy Efficiency

97

- R401.2 Compliance – simplified
  - Projects shall comply with Sections identified as "mandatory" and with either sections identified as "prescriptive" or the performance approach in Section R405
- R401.3 Certificate
  - Added provisions to include - the results from any required duct system and building envelope air leakage testing done on the building

Chapter 4 (RE) – Table R402.1.1

98

TABLE R402.1.1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR[b]	SKYLIGHT[b] *U*-FACTOR	GLAZED FENESTRATION SHGC[b, e]	CEILING *R*-VALUE	WOOD FRAME WALL *R*-VALUE	MASS WALL *R*-VALUE[i]	FLOOR *R*-VALUE	BASEMENT[c] WALL *R*-VALUE	SLAB[d] *R*-VALUE & DEPTH	CRAWL SPACE[c] WALL *R*-VALUE
1	NR	0.75	0.25	30	13	3/4	13	0	0	0
2	0.40	0.65	0.25	38	13	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10 /13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5 or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5 or 13+10[h]	19/21	38[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. *R*-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in Climate Zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.

d. R-5 shall be added to the required slab edge *R*-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. Or insulation sufficient to fill the framing cavity, R-19 minimum.

h. First value is cavity insulation, second is continuous insulation or insulated siding, so "13+5" means R-13 cavity insulation plus R-5 continuous insulation or insulated siding. If structural sheathing covers 40 percent or less of the exterior, continuous insulation *R*-value shall be permitted to be reduced by no more than R-3 in the locations where structural sheathing is used – to maintain a consistent total sheathing thickness.

i. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Chapter 4 (RE) Table R402.1.3

99

TABLE R402.1.3
EQUIVALENT *U*-FACTORS[a]

CLIMATE ZONE	FENESTRATION *U*-FACTOR	SKYLIGHT *U*-FACTOR	CEILING *U*-FACTOR	FRAME WALL *U*-FACTOR	MASS WALL *U*-FACTOR[b]	FLOOR *U*-FACTOR	BASEMENT WALL *U*-FACTOR	CRAWL SPACE WALL *U*-FACTOR
1	0.50	0.75	0.035	0.082	0.197	0.064	0.360	0.477
2	0.40	0.65	0.030	0.082	0.165	0.064	0.360	0.477
3	0.35	0.55	0.030	0.057	0.098	0.047	0.091[c]	0.136
4 except Marine	0.35	0.55	0.026	0.057	0.098	0.047	0.059	0.065
5 and Marine 4	0.32	0.55	0.026	0.057	0.082	0.033	0.050	0.055
6	0.32	0.55	0.026	0.048	0.060	0.033	0.050	0.055
7 and 8	0.32	0.55	0.026	0.048	0.057	0.028	0.050	0.055

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.
b. When more than half the insulation is on the interior, the mass wall *U*-factors shall be a maximum of 0.17 in Climate Zone 1, 0.14 in Climate Zone 2, 0.12 in Climate Zone 3, 0.087 in Climate Zone 4 except Marine, 0.065 in Climate Zone 5 and Marine 4, and 0.057 in Climate Zones 6 through 8.
c. Basement wall *U*-factor of 0.360 in warm-humid locations as defined by Figure R301.1 and Table R301.1.

Chapter 4 (RE) Building Thermal Envelope

100

- R402.2.3 Eave baffle
  - For air permeable insulations in vented attics, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle shall be permitted to be any solid material.



Chapter 4 (RE) Table R402.2.6

101

- R402.2.6 Steel-frame ceilings, walls, and floors

TABLE R402.2.6
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION (*R*-VALUE)

WOOD FRAME *R*-VALUE REQUIREMENT	COLD-FORMED STEEL EQUIVALENT *R*-VALUE[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing
R-38	R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10
Steel-Framed Wall 16" O.C.	
R-13	R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1
R-13 + 3	R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7
R-20	R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5
R-20 + 5	R-13 + 12.7 or R-15 + 12.3 or R-19 + 11.6 or R-21 + 11.3 or R-25 + 10.9
R-21	R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7
Steel Framed Wall, 24" O.C	
R-13	R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4
R-13 + 3	R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1
R-20	R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9
R-20 + 5	R-13 + 11.5 or R-15 + 10.9 or R-19 + 10.1 or R-21 + 9.7 or R-25 + 9.1
R-21	R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9
Steel Joist Floor	
R-13	R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10
R-19	R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10

a. Cavity insulation *R*-value is listed first, followed by continuous insulation *R*-value.
b. Insulation exceeding the height of the framing shall cover the framing.

Chapter 4 (RE) Building Thermal Envelope

102

- R402.2.12 Sunroom insulation (reorganized)
  - All sunrooms must meet the insulation requirements of this chapter
  - Exceptions – with thermal isolation
    - Minimum ceiling insulation R-values remain the same
    - Minimum Wall R-values remain the same
      - ~~New~~ walls separating the sunroom <u>with a thermal isolation</u> from conditioned space shall meet the building thermal envelope requirements of this code

Chapter 4 (RE)
Building Thermal Envelope

103

- R402.2.3.5 Sunroom *U*-factor
  - All sunrooms enclosing conditioned space must meet the fenestration requirements of this chapter
  - Exception – sunrooms with thermal isolation and enclosing conditioned space
    - Climate Zones 4 – 8
      - Maximum *U*-factor 0.45
      - Maximum skylight *U*-factor 0.70
    - New fenestration separating the sunroom from the conditioned space shall meet the building thermal envelope requirements

Chapter 4 (RE) Air Leakage

104

- R402.4 Air leakage
  - R402.4.1 Building thermal envelope shall comply with Sections R402.4.1.1 and R402.4.1.2.
    - The sealing methods between dissimilar material shall allow for differential expansion and contraction
    - Removed – the itemized list of where to caulk, gasket, weatherstrip or otherwise seal with an air barrier material, suitable film or solid material

Chapter 4 (RE)
Building Thermal Envelope

105

- R402.4.1.1 Installation. The components of the building thermal envelope as listed in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria listed in Table R402.4.1.1, as applicable to the method of construction
  - Where required by the code official, an approved third party shall inspect all components and verify compliance

Chapter 4 (RE) Table R402.4.1.1

106

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	CRITERIA[a]
Air barrier and thermal barrier	A continuous air barrier shall be installed in the building envelope. Exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed. Air-permeable insulation shall not be used as a sealing material.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop down stair or knee wall doors to unconditioned attic spaces shall be sealed.
Walls	Corners and headers shall be insulated and the junction of the foundation and sill plate shall be sealed. The junction of the top plate and top of exterior walls shall be sealed. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier. Knee walls shall be sealed.
Windows, skylights and doors	The space between window/door jambs and framing and skylights and framing shall be sealed.
Rim joists	Rim joists shall be insulated and include the air barrier.
Floors (including above-garage and cantilevered floors)	Insulation shall be installed to maintain permanent contact with underside of subfloor decking. The air barrier shall be installed at any exposed edge of insulation.
Crawl space walls	Where provided in lieu of floor insulation, insulation shall be permanently attached to the crawlspace walls. Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.
Narrow cavities	Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be air tight, IC rated, and sealed to the drywall.
Plumbing and wiring	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	Exterior walls adjacent to showers and tubs shall be insulated and the air barrier installed separating them from the showers and tubs.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air sealed boxes shall be installed.
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the sub-floor or drywall.
Fireplace	An air barrier shall be installed on fireplace walls. Fireplaces shall have gasketed doors.

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Chapter 4 (RE) Air Leakage

107

- R402.4.1.2 Testing
  - The building or dwelling unit shall be tested with a blower door at a pressure of 0.2 w.g.(50 Pa)and verified as having an air leakage rate of not exceeding
    - 5 air changes per hour – Climate Zones 1 and 2
    - 3 air changes per hour – Climate Zones 3 through 8
  - Where required by the code official, testing shall be conducted by an approved third party
  - A written report of the results shall be signed by the party conducting the test and provided to the code official

Chapter 4 (RE) Air Leakage

108

- R402.4.1.2 Testing shall be performed at any time after the creating of all penetrations of the building thermal envelope. During testing:
  - Exterior windows and doors shall be closed, but not sealed, beyond the intended weatherstripping or other infiltration control measures;
  - Dampers including exhaust, intake, makeup air, backdraft and flue dampers shall be closed, but not sealed beyond intended infiltration control measures;
  - Interior doors, if installed at the time of the test, shall be open
  - Exterior doors for continuous ventilation systems and heat recovery ventilators shall be closed and sealed;
  - Heating and cooling systems, if installed at the time of the test, shall be turned off; and
  - Supply and return register, if installed at the time of the test, shall be fully open
- ~~402.4.2.2 Visual inspection option~~

Chapter 4 (RE) Air Leakage

109

- R402.4.2 Fireplaces. New wood-burning fireplaces shall have tight-fitting flue dampers and outdoor combustion air

Chapter 4 (RE) Air Leakage

110

- R402.4.4 Recessed lighting
  - Removed wording – having an air leakage rate not more than 2.0 cfm ~~of air movement from the conditioned space to the ceiling cavity~~

Chapter 4 (RE) Systems

111

- R403.2.2 Duct Sealing
- Added Exceptions
  - Air-impermeable spray foam permitted without additional joint seals
  - For a duct connection that is partially inaccessible
    - Three screws equally spaced on the exposed portion of the joint so as to prevent a hinge effect
  - Continuously welded and locking-type logitudinal joints and seams
    - Ducts operation at static pressures less than 2" w.g. (500 Pa)

Chapter 4 (RE) Systems

112

- R403.2.2 Duct Sealing
  - Post-Construction test
    - Removed Leakage to outdoors test
    - Changed leakage rate from 12 cfm to 4 cfm, with air handler
  - Rough-in test
    - Changed leakage rate
      - Total leakage from 6 cfm to 4 cfm, with air handler
      - Total leakage from 4 cfm to 3 cfm, without air handler
  - Exception changed
    - Air handler and ducts located entirely within the building thermal envelope

Chapter 4 (RE) Systems

113

- R403.2.2.1 Sealed air handler (new)
  - Manufacturer's designation for air leakage of no more than 2% of the design flow rate required
    - ASHRAE 193
- R403.2.3 Use of building cavities as ducts or plenums prohibited

Chapter 4 (RE) Systems

114

- R403.3.1 Protection of piping insulation (new)
  - Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance, and wind, and shall provide shielding from solar radiation that can cause degradation of the material
  - Adhesive tape shall not be permitted

Chapter 4 (RE) Systems

115

- R403.4 Service hot water systems
  - R403.4.1 Circulating hot water systems
    - Removed insulation requirements
  - R403.4.2 Hot water pipe insulation (Prescriptive) (new)
    - R3 required on piping
      - Larger than ¾" diameter
      - Serving more than one dwelling unit
      - From the water heater to kitchen outlets
      - Located outside the conditioned space
      - From the water heater to a distribution manifold
      - Located under a floor slab
      - Buried
      - Recirculation systems except demand recirculation system
      - Run lengths greater than the maximum in Table R403.4.2

TABLE R403.4.2
MAXIMUM RUN LENGTH (feet)[a]

Nominal Pipe Diameter of Largest Diameter Pipe in the Run (inch)	3/8	1/2	3/4	> 3/4
Maximum Run Length	30	20	10	5

For SI: 1 inch = 25.4 mm, 1 foot 304.8 mm.
a. Total length of all piping from the distribution manifold or the recirculation loop to a point of use.

Chapter 4 (RE) Systems

116

- R403.5 Mechanical ventilation
  - Meets IRC or IMC or other approved means
- R403.5.1 Whole-house mechanical ventilation system fan efficacy (new)
  - Meet efficacy requirements of Table R403.5.1
    - Exception – fans integral to HVAC equipment

TABLE R403.5.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

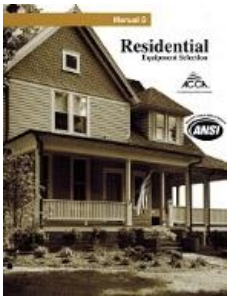
FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom, utility room	10	1.4 cfm/watt	< 90
Bathroom, utility room	90	2.8 cfm/watt	Any

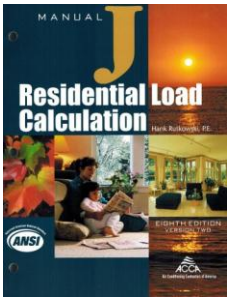
For SI: 1 cfm = 28.3 L/min.

Chapter 4 (RE) Systems

117

- R403.6 Equipment Sizing
  - Sized in accordance with ACCA Manual S
  - Based on loads calculated with ACCA Manual J





Chapter 4 (RE) Systems

118

- R403.9 Pools and inground permanently installed spas
  - R403.9.1 Heaters
    - On-off switch to be mounted outside of the heater
  - R403.9.2 Time switches
    - Heaters, pumps and motors with built in times shall be deemed in compliance
  - R403.9.3 Covers
    - Added inground permanently installed spas
    - Removed R-value requirements for pools heated to more than 90^{o}F

Chapter 4 (RE)
Electrical Power and Lighting

119

- R404.1 Lighting equipment
  - Increased minimum of high-efficacy lamps to 75%
  - Added exception for low-voltage lighting
  - Added R404.1.1 Lighting equipment
    - Fuel gas lighting systems shall not have continuously burning pilot lights

Chapter 4 (RE)
Simulated Performance Alternative

120

- R405.4 Documentation and R405.5 Calculation procedure had language added for clarification
- R405.6 Calculation software tools
  - Calculation of whole-building sizing for HVAC equipment in the standard reference design in accordance with R403.6 not IRC

Chapter 4 (RE) Table R405.5.2(1)

121

- Glazing
  - Changed - Interior shade fraction: 0.92-(0.21 x SHGC for the standard reference design) – same for Standard Reference and Proposed Designs
- Air exchange rate
  - Changes to both Standard Reference and Proposed Designs
- Changes to footnotes
  - b, c, and g

Chapter 4 (RE) Table R405.5.2(1)

122

- Heating systems
  - Standard Reference – where the proposed design utilizes electric heating without a heat pump the standard reference design shall be an air source heat pump – meeting Section R403 – IECC – Commercial Provisions
- Thermal distribution system
  - Removed requirements in Standard Reference Design
  - Proposed Design – system shall be tested as specified in Table R405.5.2(2).

Chapter 5 (RE) Referenced Standards

123

- No changes